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DEPARTMENT OF TRADE
AND INDUSTRY

REC'D 06 JUN 2003
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This is to certify that

the documents annexed hereto are true copies of:

Application forms P.1 and P. 2, provisional specification and drawings of South African Patent Application No. 2001/5467 as originally filed in the Republic of South Africa on 3 July 2001 and post-dated to 3 January 2002 in the name of NXCO INTERNATIONAL LIMITED for an invention entitled: " DUAL SHOCKWAVE CONCENTRATOR ".

Geteken te / Signed at PRETORIA in die Republiek van Suid-Afrika, hierdie / in the Republic of South Africa, this 15th dag van / day of May 2003

Registrateur van Patente
Registrar of Patents

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FORM P2
M R & F Ref: P.19161/Case 11

REPUBLIC OF SOUTH AFRICA

PATENTS ACT, 1978

Post-dated

REGISTRAR OF PATENTS

Official Application No.			Lodging date: Provisional		Acceptance date:	
21	01	20015467	22	~~3 JULY 2001~~ 3.1.2002	47	
International classification			Lodging date: Complete		Granted date:	
51			23			

Full name(s) of applicant(s)/Patentee(s)	
71	NXCO INTERNATIONAL LIMITED

Applicant(s) substituted:		Date Registered:
71		

Assignee(s):		Date Registered:
71		

Full name(s) of inventor(s)	
72	To be advised

Priority claimed		Country		Number		Date
Note:	33	NONE	31	NONE	32	NONE
Use International	33		31		32	
Abbreviation for Country	33		31		32	

Title of Invention:	
54	DUAL SHOCKWAVE CONCENTRATOR

Address of applicant(s)/patentee(s)

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Address for Service:	
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Patent of Addition No.		Date of any change:	
61			
Fresh Application based on:		Date of any change:	

McCALLUM, RADEMEYER & FREIMOND
Ref: P19161/Case 11

FORM P1

REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978

APPLICATION FOR A PATENT AND ACKNOWLEDGEMENT OF RECEIPT

(Section 30(1) - Regulation 22)

The grant of a patent is hereby requested by the undermentioned applicant on the basis of the present application filed in duplicate

R10 R50

OFFICIAL APPLICATION NO.

21	01	20015467

FULL NAME(S) OF APPLICANT(S)

71	NXCO INTERNATIONAL LIMITED

ADDRESS(ES) OF APPLICANT(S)

Saffrey Square, Suite 205, Bank Lane, Nassau, Bahamas

TITLE OF INVENTION

54	DUAL SHOCKWAVE CONCENTRATOR

Priority is claimed as set out on the accompanying Form P2.
The earliest priority claimed is :

This application is a patent of addition to Patent Application No.	21	01	
This application is a fresh application in terms of section 37 and based on Application No.	21	01	

THIS APPLICATION IS ACCOMPANIED BY:

X	1	A single copy of a provisional specification of 10 pages
	2	Two copies of a complete specification of .... pages
X	3	2 . sheets of Informal Drawings
	4	.... sheets of Formal Drawings
	5	Publication particulars and abstract (Form P8 in duplicate)
	6	A copy of Figure .... of drawings (if any) for the abstract
	7	Assignment of Invention
	8	Certified priority document(s) Number(s)
	9	Translation of priority document(s)
	10	An assignment of priority rights
	11	A copy of the Form P2 and the specification of SA Patent Application No. 21 01
	12	A declaration and power of attorney on Form P3
	13	Request for ante-dating on Form P4
	14	Request for classification on Form P9
X	15	Form P2 in duplicate

74	ADDRESS FOR SERVICE: McCALLUM, RADEMEYER & FREIMOND, Maclyn House, June Avenue, Bordeaux P.O. Box 1130, Randburg, 2125

Dated this 3rd day of July 2001.

REGISTRAR OF THE COURT OF THE COMMISSIONER OF PATENTS

3 · 1 · 2002 Post-dated

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McCALLUM, RADEMEYER & FREIMOND
PATENT AGENTS FOR APPLICANT(S)

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P.19161/Case 11

FORM P6

REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978

PROVISIONAL SPECIFICATION

(Section 30(1) - Regulation 27)

Post-dated

OFFICIAL APPLICATION NO				LODGING DATE
21	01	20015467	22	3.1.2002 3 ~~JULY 2001~~

FULL NAME(S) OF APPLICANT(S)

71	NXCO INTERNATIONAL LIMITED

FULL NAME(S) OF INVENTOR(S)

72	To be advised

TITLE OF INVENTION

54	DUAL SHOCKWAVE CONCENTRATOR

BACKGROUND OF THE INVENTION

This invention is concerned generally with a customized low energy method of breaking rock in a controlled manner.

As used herein the word "rock" includes rock, ore, coal, concrete and any similar hard mass, whether above or underground which is difficult to break or fracture. It is to be understood that "rock" is to be interpreted broadly.

A number of techniques have been developed for the breaking of rock using non-explosive means. These include a carbon dioxide gas pressurisation method (referred to as the Cardox method), the use of gas injectors (the Sunburst technique), hydrofracturing and various methods by which cartridges containing energetic substances pressurise the walls or base of a sealed drill hole to produce penetrating cone fractures (known as PCF).

These techniques may be an order of magnitude more efficient than conventional blasting in that they require approximately 1/10 of the energy to break a given amount of rock compared to conventional blasting using high explosives. The lower energy reduces the resulting quantity of fly rock and air blast and to an extent allows the rockbreaking operation to proceed on a continuous basis as opposed to the batch-type situation, which prevails with conventional blasting.

Most non-explosive rockbreaking techniques rely on the generation of high gas pressures to initiate a tensile fracture at the bottom of a relatively short

drill hole. If the force which is generated by the high gas pressure can be optimally used then the efficiency with which rock is broken is increased.

In the aforementioned technique when the propellant is initiated a shock wave is generated which propagates away from the point of initiation. It is desirable to be able to reinforce the shock wave or increase the energy density which is obtainable from the ignited propellant so that localised high pressure regions can be generated to initiated rock fracture at predetermined points.

SUMMARY OF INVENTION

According to a first aspect of the invention there is provided a method of breaking rock which includes the steps of creating at least two pressure waves, resulting from initiation of a propellant or propellants, and allowing the pressure waves to interfere with each other at a predetermined region.

In one form of the invention each pressure wave is generated by initiating a respective propellant.

In a different form of the invention the pressure waves are generated by initiating a propellant at two respective points which are spaced from each other.

The pressure waves may be generated inside a single enclosure. In a different form of the invention each pressure wave is generated inside a respective enclosure.

According to a different aspect of the invention there is provided a method of breaking rock which includes the steps of:

(a) loading a cartridge into a hole in a rock face;

(b) initiating a propellant in the cartridge, at least at first and second points which are spaced from each other in the cartridge, thereby to generate at least two wave fronts which are caused to interact with each other, each wave front causing the release of pressurised material; and

(c) confining the pressurised material in the cartridge.

The cartridge may be elongate and the first and second points may be located respectively at opposed ends of the cartridge.

The initiation of the propellant at the first and second points may occur substantially simultaneously or initiation at one point may take place at a predetermined time interval after initiation at the other point.

According to another form of the invention there is provided a method of breaking rock which includes the steps of loading first and second cartridges into a hole in a rock face and initiating respective propellants in the cartridges at respective first and second points thereby to cause the generation of shock waves which are allowed to interact with each other at a location which is between the said first and second points.

The invention further extends to apparatus for breaking rock which includes a cartridge which forms an enclosure, a propellant inside the enclosure and at

least first and second initiators for igniting the propellant at respective first and second points which are spaced from each other inside the cartridge.

In another form of the invention there is provided apparatus for breaking rock which includes first and second cartridges, each cartridge forming a respective enclosure for a respective propellant, each cartridge including an initiator for igniting the propellant in the respective enclosure, and wherein the cartridges are positioned in an assembly wherein the initiators are at opposed remote points on the assembly.

As used herein "propellant" is to be interpreted broadly to include a blasting agent, propellant, explosive, gas-evolving substance or similar means which, once initiated, generates high pressure jet material typically at least partly in gaseous form. A propellant of this type is known in the art. "Blasting agent" and "propellant" are used interchangeably in this specification.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is further described by way of examples with reference to the accompanying drawings Figures 1 to 3 which respectively illustrate apparatus for breaking rock in accordance with different embodiments of the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

Figure 1 of the accompanying drawings illustrates a hole 10 which is drilled into a rock mass 12 from a face 14 using conventional drilling equipment, not shown.

A cartridge 16 is loaded into the hole. The cartridge has a base 18 which rests on a bottom 20 of the hole and a cylindrical side wall 22 which extends upwardly from the base and which, at an end which is remote from the base, has a rounded shape 24.

The cartridge is made from a malleable material which in this specification means a material which is capable of plastic deformation, without rupturing, at least to a predetermined extent. By way of example at least the wall 22 is made from a high density plastics material such as high density polypropylene.

The cartridge 16 forms an enclosure for a propellant material 26 which is of known composition. The propellant is loaded into the cartridge under factory conditions using techniques which are known in the art.

A first initiator 28 is engaged with the cartridge. The initiator is located at the rounded upper end 24 of the cartridge. A second initiator 30, which may be identical to the initiator 28, is engaged with the base 18 of the cartridge.

Control wires 32 and 34 extend from the two initiators to a control unit, not shown, which is of conventional construction.

Stemming 40 is placed into the hole 10 from the rock face 14 covering the cartridge to a desired extent. The stemming is tamped in position using techniques which are known in the art. The nature of the stemming and its manner of use are known and for this reason are not further described herein.

The control wires 32 and 34 may be electrically connected to each other or alternatively may extend separately to the control unit. In the former case one control signal may be impressed on the wires to energise the initiators 28 and 30 substantially simultaneously. In the second instance however separate control signals are impressed on the wires 32 and 34 respectively to energise the initiators 28 and 30. With this form of the invention it is possible to fire the initiators at intervals which are slightly spaced, by a predetermined time interval, from each other.

When the initiators are fired the propellant material 26 in the region of each initiator is ignited and a rapid combustion process takes place which gives rise to the generation of two high pressure shock waves which advance towards each other from respective ends of the cartridge ie. from the initiators 28 and 30. The shock waves are accompanied by the release of high pressure jet materials which are substantially in gaseous form. The shock waves advance towards each other and depending on physical conditions inside the cartridge and the times at which the initiators are fired interfere or meet with each other

approximately at a central region, designated 50, of the cartridge. Interference of the shock waves gives rise to a high pressure, or high stress region, more or less at the middle of the cartridge.

Initially the cartridge contains the expanding high pressure jet material and deforms outwardly, without rupturing, so that the wall 22 of the cartridge is forced into intimate sealing contact with an opposing surface of the wall of the hole 12. The cartridge does not fracture during this process for, as noted, it is preferably fabricated from a plastically deformable material.

The cartridge thus effectively confines the high pressure gas and the wall of the cartridge, since it is in close contact with the wall of the hole, effectively reinforces the wall.

The central region of the cartridge is, as noted, the region at which high stress concentrations occurs due to the interference of the two shock waves with each other. Consequently when the cartridge ruptures the rock in the vicinity of the region 50 is initially fractured by the high pressure jet material.

It follows that by confining the high pressure jet material inside the cartridge and by allowing the two shock waves to interfere with each other the cartridge can be caused to fracture at a desired point which means that the force which is released by the combusting propellant can then be directed onto a chosen surface of the wall of the hole adjacent the point or region at which the shock waves interfere.

Figure 1 also illustrates a variation of the invention. A dotted line 52 indicates that the volume which is occupied by the cartridge 16 could be occupied by two relatively smaller cartridges designated 16A and 16B respectively. Each cartridge carries a respective initiator 28 or 30, substantially as shown in the drawing.

The cartridges are however orientated so that their respective bases, designated by the dotted line 52, abut each other with the cartridge assembly, which is elongate, being such that the initiators 28 and 30 are at opposed respectively points of the elongate assembly. The initiators are fired substantially simultaneously and shock waves in each respective cartridge are then propagated towards the respective bases at which point the shock waves interfere with each other, substantially in the manner which has been described and give rise, again, to a high stress region. In this case however the bases of the cartridges act to deflect the shock waves outwardly and, through suitable design, this feature can be used to enhance the high stress region yet further. For example it is possible to form each base with a conical shape, as is indicated by means of dotted lines 54A and 54B respectively, so that the shock waves are initially deflected radially outwardly before interacting directly with each other.

Figure 2 illustrates an arrangement which is similar in many respects to what has been shown in Figure 1 and where applicable like reference numerals are used to designate like components.

The initiators which are used in the arrangement of Figure 2 are, in this instance, made from an inert material such as carbon wire and are designated respectively 28A and 28B and are positioned adjacent a surface of the wall 22 of the cartridge. The initiators are directly exposed to the propellant 26 and are fixed under factory conditions to the cartridge 16. The control wires 32 and 34 which lead to the initiators are embedded in the wall of the cartridge.

In the arrangement shown in Figure 3 each initiator is constituted by a substantially circular loop of filament wire 28X and 28Y respectively. As is the case with the Figure 2 embodiment each filament wire is made from an inert material such as carbon wire. "Inert" in this sense means a material which, in the absence of an electric current passing through the material, is not capable of emitting a spark or showing any other phenomenon which can cause ignition of a propellant. With the arrangement of Figure 3 the blasting agent is initiated, at each of two spaced locations, over a relatively substantial distance or area, or at a plurality of points. In the arrangement shown in Figure 2 on the other hand initiation takes place at relatively small regions which are spaced from each other. Different types of shock waves are produced depending on the manner of initiation. Nonetheless the principle remains the same which is that the shock waves are allowed to interfere with each other at a location which is between the points at which they originate in order to cause a localised high energy region which causes rock fracture in the vicinity of the region.

Dated this 3rd day of July 2001.

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Patent Agents for the Applicant

NXCO INTERNATIONAL LIMITED
PROVISIONAL PATENT APPLICATION

20015467

FIG 2

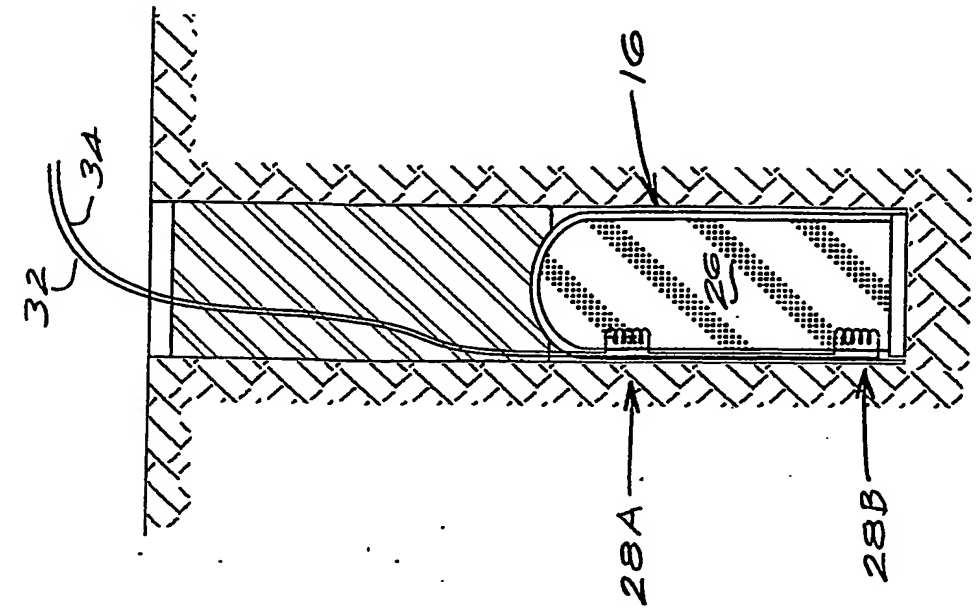

FIG 1

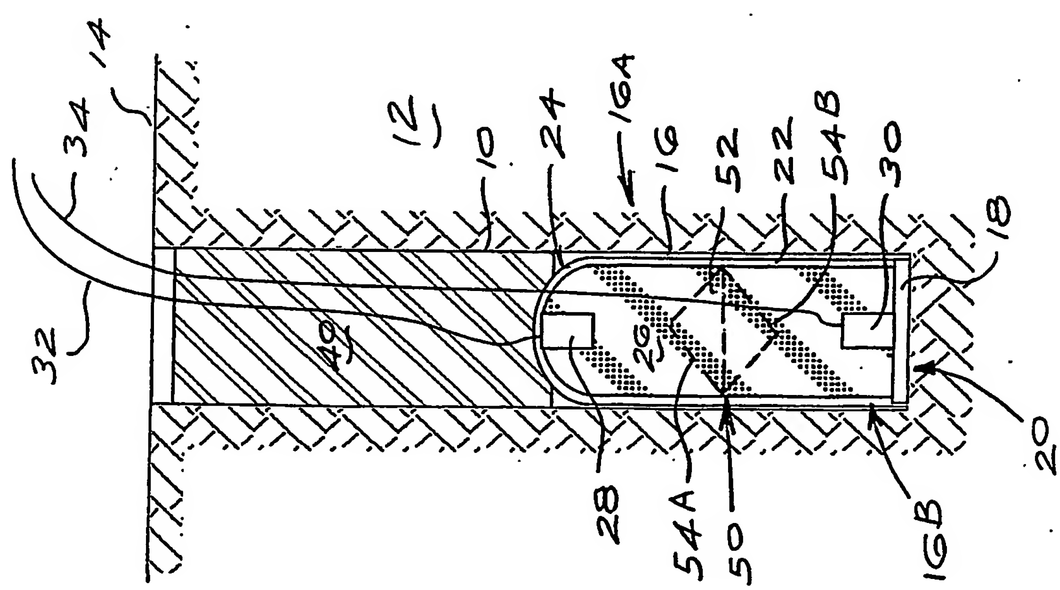

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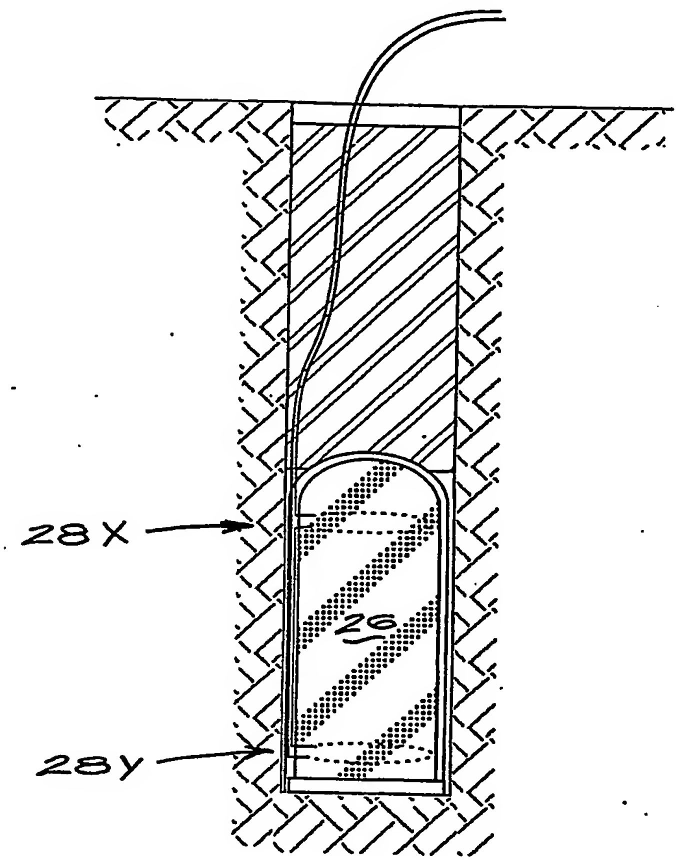
FIG 3



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